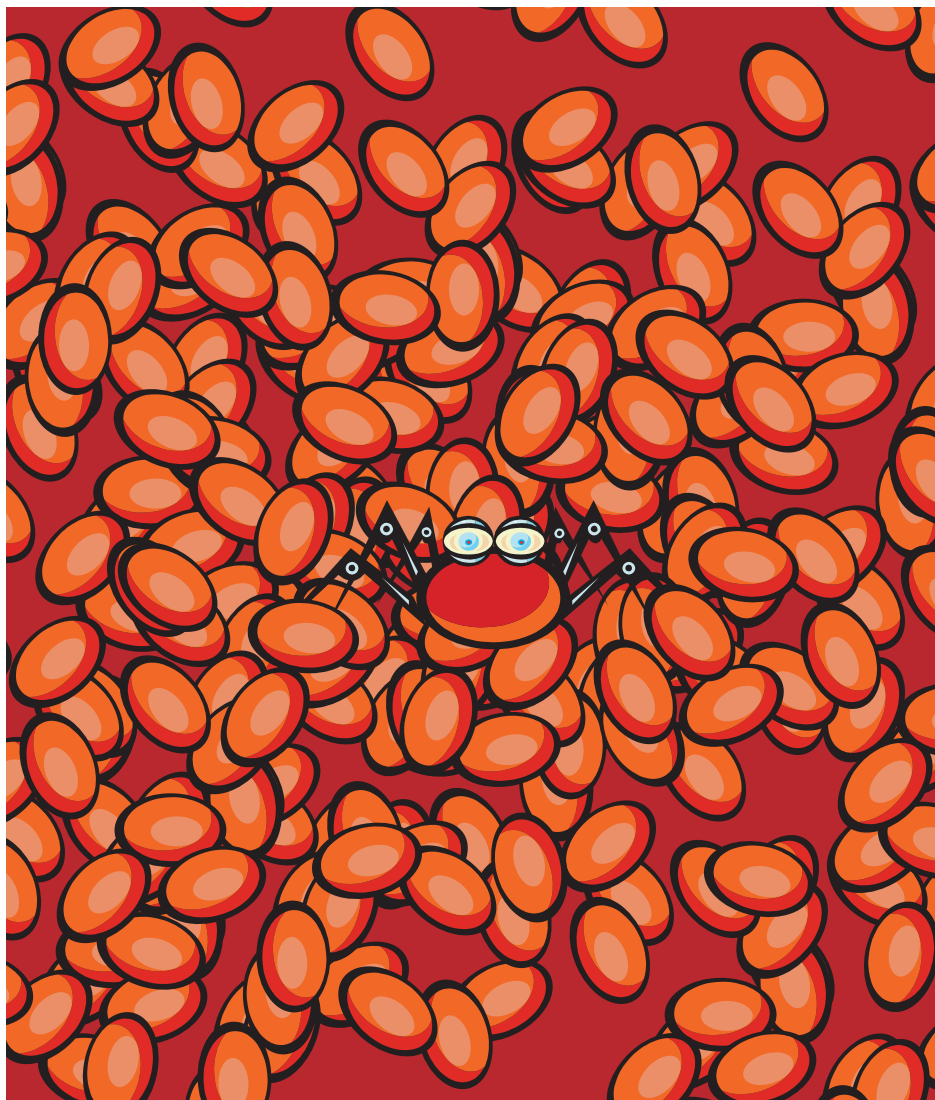


Tiny Technology Moves Into the Big Time

No longer just a concept, nanoscience could drive the next industrial revolution.

By Jo Anne Bourquard



The Diamond Age by Neal Stephenson describes a 21st century “nanotech” society in which nations no longer exist and microscopic computers are used to do everything—from birth control to muscle building to surveillance. How far fetched is this futuristic scenario?

The science of the very small—nano-sci-

ence—is developing rapidly, and some predict it will drive the next industrial revolution. Nanoscience refers to the manipulation and control of matter at the nano level (a nanometer is one billionth of a meter), according to the National Science Foundation. A nanometer is something you’d normally not be able to see—a sheet of paper is 100,000 nanometers thick, and a human red blood cell is more than 2,000 nanometers long. At the nano level, physical, chemical

and biological properties of materials differ greatly, making it possible to develop machines and products with novel functions.

THE PROMISE

Nanotechnology is no longer just a concept. Nanoparticles are used to coat fabrics making them stain repellent and to create scratch-resistant surfaces for floors and cars. Nanoscale chemicals with the ability to absorb UV light are used to produce sunscreen without chalky residue. Silver nanocrystals are used to create antimicrobial bandages and to retard fungal and bacterial growth in appliances and air conditioners. The semi-conductor industry is using nanotechnology to create more powerful chips. Super strong tennis rackets, longer acting tennis balls, self correcting golf balls, windshield cleaners that repel rain, snow and bugs, and skin lotion customized for various weather conditions are some of the nanotech products currently on the market.

In the environmental arena, nanoproducts are expected to be a boon to water purification, clean energy and pollution control systems. Nanotechnology also offers the promise of detecting and preventing disease. It’s expected to aid in the early diagnosis of Alzheimer’s, cancer and heart disease, and scientists predict nanoproducts at work inside the body could destroy cancer cells, deliver drugs and act as artificial muscles. In the IT world, nanomolecules with the ability to store memory will be used to create even smaller, more efficient electronic devices. Nanotechnology might even move the Internet to light speed.

MARKET POTENTIAL

The National Science Foundations predicts the global market for nanotechnologies will reach \$1 trillion in the next 20 years. Last year, the U.S. Patent and Trademark Office created a whole new registration category just for nanotechnology inventions.

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A May 2005 report by the President's Council of Advisors on Science and Technology warns that while the United States is the leader in nanotechnology research, it is facing increasing competition as other nations ramp up their own programs.

"The U.S. leads the word in nanotechnology today, but its position is tenuous," says Matthew Nordan, vice president of research with Lux Research. He says for the country to stay in the lead, more money needs to be devoted to nanotech research and federal regulators need to "eliminate the uncertainty surrounding environmental, health and safety issues." Nordan says the country also has to do a better job of retaining foreign students with advanced degrees.

More than \$4 billion has been spent since FY 2001 on nanotechnology research and development, according to the President's Council. Of the approximately \$9 billion annual worldwide spending on nanotechnology, the combined U.S. federal, state and private investment is about one-third.

A 2004 report by Lux Research indicates state and local governments have invested more than \$400 million in nanotechnology research, facilities and business incubation

programs, with California, Colorado and Massachusetts, leading the way in nanotechnology development.

Arkansas passed legislation this session that sets aside \$5 million to help the University of Arkansas prepare a nanotechnology research facility. A new law in Connecticut promotes more research by Connecticut colleges and universities and creates a nanotechnology program to accelerate the entry of students into related science programs. At the direction of the General Assembly, the Virginia Joint Commission on Technology and Science began a study of nanotechnology research and development in 2004, which continues through 2005.

THE DANGERS

Some have raised concerns that nanotechnology could be extremely dangerous if not appropriately regulated. Experts, such as U.K. Health and Safety Executive John Howard, point out that relative to their size, nano particles are more toxic than larger particles. As we are still learning about the unique structures and properties of nanoparticles, he recommends great care to ensure worker protection. One of the benefits of nanotechnology

is that it will support the inexpensive development of a variety of powerful machines and devices. But the question remains what impact all these powerful new products will have on the environment and humans. Christine Peterson, chair of the Foresight Nanotech Institute, a nonprofit organization that focuses on the beneficial implementation of nanotechnology, raises concerns that nanotechnology in the wrong hands could be extremely dangerous. Nanoscience could be used to create a terrorist weapon that is "potentially tougher and smarter," for example, than anthrax spores.

The report by the President's Council of Advisors on Science and Technology acknowledges there are potential environmental, health and safety risks associated with the technology and promises that the federal government will set standards and regulations to protect the public and the environment.

Nanotechnology provides an entirely new way to produce products, and that has the potential to affect all our existing industries. Just as the Internet brought dramatic changes to society and the workplace, nanotechnology may bring with it a host of new challenges for policymakers to tackle. ■